Deerinwater Environmental Management Services, Inc.

FINAL REPORT
Book 1 of 2

For
The Expanded Site Investigation Phase II
Former Atlas Missile Site No. 7
Vernon, Texas

Prepared For
U.S. Army Corps of Engineers
Tulsa District
Contract No. DACA56-01-D-2005,
Task Order No. 001

February 2002

Prepared By

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Acronym List

AMS	Atlas Missile Site
ASTM	American Society of Testing Materials
bgs	below ground surface
CFR	Code of Federal Regulations
COC	Contaminate of Concern
COPC	Contaminate of Potential Concern
DEMS	Deerinwater Environmental Management Services
DO	Dissolved Oxygen
DOD	Department of Defense
EB	Equipment Blank
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Investigation
FFA	Future Farmers of America
GW	Ground Water
GWP	Ground Water Protection
HTRW	Hazardous, Toxic, Radioactive Waste
IDW	Investigative Derived Waste
LCS/LCSD	Laboratory Control Sample/Laboratory Control Sample Duplicate
MSCs	Medium Specific Concentrations
MK	Morrison Knudsen Corporation
msl	Mean Sea Level
MW	Monitoring Well
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
PA/SI	Preliminary Assessment and Site Inspection
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RRS-II	Risk Reduction Standards No. 2

SI	Site Inspection
SOP	Standard Operating Procedure
SOW	Scope of Work
SVOC	Semi-volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TCE	Trichloroethene or Trichloroethylene
TDH	Texas Department of Health
TEPH	Total Extractable Petroleum Hydrocarbons
TPH	Total Petroleum Hydrocarbons
TNRCC	Texas Natural Resource Conservation Commission
TRPH	Total Recoverable Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 Expanded Site Investigation Phase II Objectives

This report presents the results of the Expanded Site Investigation, Phase II (ESI Phase II) preformed September of 2001, at the former Atlas Missile Site No. 7 located near Vernon, Texas. The objectives of this ESI Phase II was to confirm the nature and extent of contaminants encountered during previously performed site investigations.

The ESI Phase II activities included the collection and chemical analysis of 65 surface soil samples. Collected soil samples were analyzed for the eight (8) RCRA metals, zinc, and PCBs to further define the lateral extent of existing soil contamination and to establish actual soil background concentrations. Four existing groundwater monitoring wells were redeveloped and groundwater samples collected. The collected groundwater samples were analyzed for the 8 RCRA metals, zinc, VOAs, SVOAs, Pesticides/PCBs, Herbicides, and TPH. This final ESI Phase II report discusses the physical description of the site, site history, discussion of the past and current field investigation activities, past and current investigation results, identification of potential data gaps, and recommendations for further investigation to achieve site closure under the Texas Natural Resource Conservation Commission (TNRCC) Risk Reduction Rules Standard No. 2 (RRS-II) Residential.

This final ESI Phase II report was prepared by Deerinwater Environmental Management Services, Inc. (DEMS) for the U.S. Army Corps of Engineers (USACE), Tulsa District, under Contract No. DACA56-01-D-2005, Task Order No.0001.

1.2 ESI Phase II Report Organization

Section 1 is the project introduction, this will highlight the ESI Phase II investigation goals. The historical use of the site is outlined in Section 2. Details of previous investigations are summarized in Section 3. Section 4 identifies the field investigation tasks, and Section 5 presents the analytical results of the ESI Phase II.

Section 6 is the Executive Summary, and Section 7 includes recommendations. Section 8 includes all reference material utilized in the preparation of this final report.

2.0 Site Background

2.1 Project Site Location

The former AMS No. 7 is located approximately 13 miles north-northwest of Vernon, Texas in Wilbarger County (**Figure 1**).

2.2 Regional Setting

The former Atlas Missile Site No. 7 is located in the gently rolling topography of northwestern Wilbarger County, Texas known as the Odell Sand Hills. This site has as an average elevation of 1365 feet above mean sea level (msl). Due to the sandy soils of the area, the surface drainage system in the Odell Sand Hills is poorly developed.

2.3 Site Background Information

2.3.1 Site History

Department of Defense (DOD) use began in 1960 with the acquisition of land at various locations in Oklahoma and Texas to be used for Atlas Missile Sites. Improvements at each site included underground missile silos, quonset huts, underground launch control centers, septic systems, water supply, fences, and roads. The AMS sites were declared to be excessive, by the DOD in approximately 1967. The United States Government, acting through the Department of Health, Education and Welfare, conveyed the property formerly AMS No. 7 by deed without warranty to the Northside Independent School District.

2.3.2 Site Ownership

The current property owner is the Northside Independent School District. The School district uses the facility for Future Farmers of America (FFA) exhibitions and livestock shows.

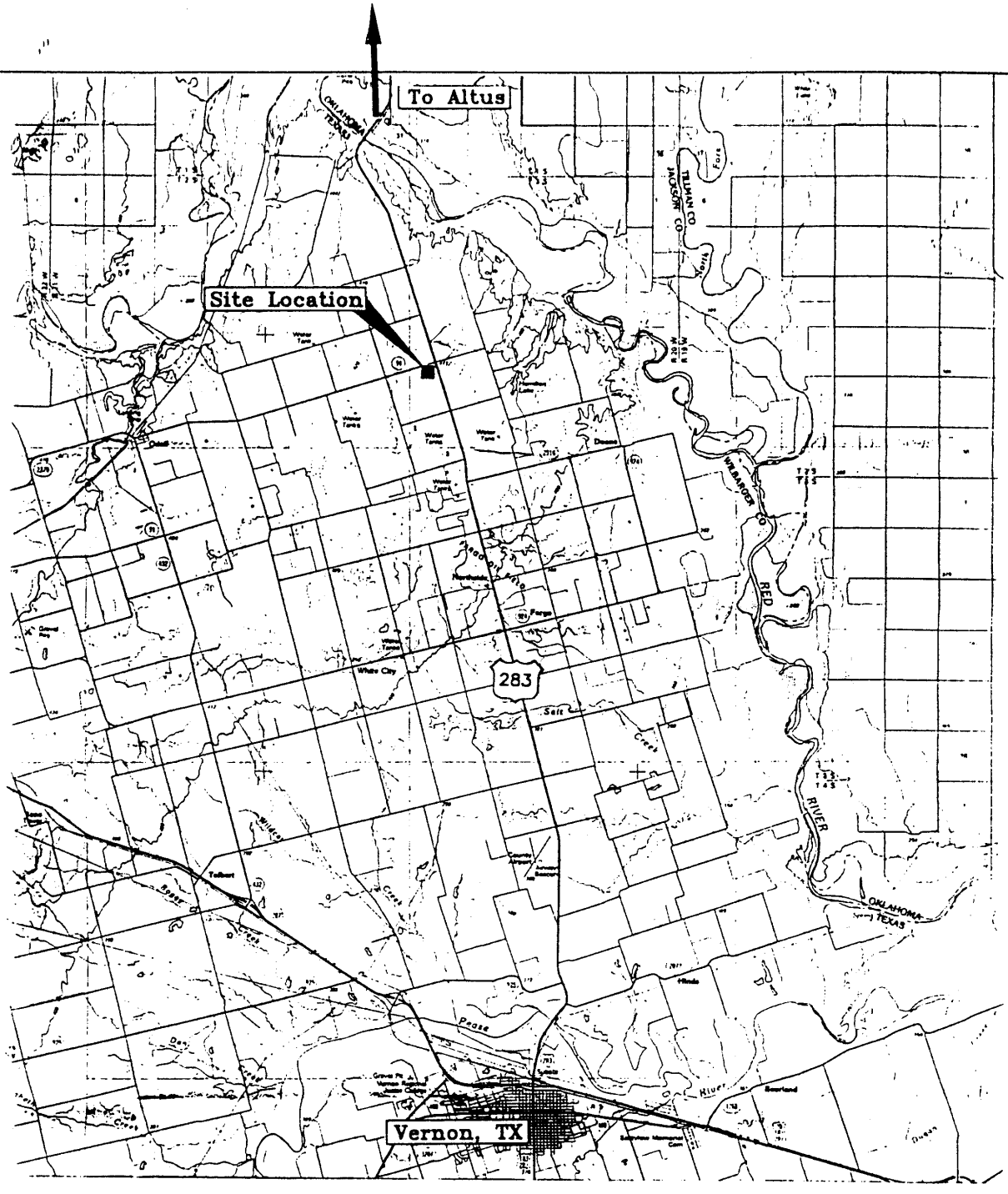

Figure 1

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Vernon, TX
Site Vicinity Map

D•E•M•S

DESIGNED BY	E. PENN	12/13/01	CHECKED BY	J. PIONESSA	12/13/01
DRAWN BY	G. FLICK	12/13/01	APPROVED BY	J. PIONESSA	12/13/01

SCALE:	DRAWING NO.	SHEET NO.	REVISION NO.
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2.4 Regional and Site Physiography, Geology and Underlying Aquifers

The near surface stratigraphic units consist of Quaternary age surficial deposits and underlying Permian age redbeds. The surficial deposits at the site consist of a thin mantle of recent age wind-blown sands and silt, that overly the Pleistocene age Seymour formation (Willis and Knowles, 1953). The Seymour formation is fluvial in origin and is comprised of fine to medium grained sands with interbedded silts and clays. Previous investigations at AMS No. 7 reported a thickness of Quaternary age surficial deposits ranging from 42 to 80 feet thick. The Seymour formation rests directly on the Permian age San Angelos formation of the Peace River Group. The Seymour Aquifer is the major groundwater aquifer for Wilbarger County. The aquifer is used locally for water supply and irrigation. The Seymour Aquifer is unconfined. The underlying San Angelos Formations is a minor aquifer in Wilbarger County. It has not been determined in past and current investigations that the San Angelos aquifer is under confined conditions or in connection with the overlying Seymour aquifer.

Four (4) monitoring wells were installed during the Expanded Site Investigation conducted by Morrison Knudsen Corporation (MK) in 2000. **Table 2.4** summarizes the total depth, producing aquifer, and elevation for each monitoring well as recorded during ESI field activities performed in 2000 by MK. Detailed well construction diagrams and well bore hole logs can be found in **Appendix K**.

Table 2.4

Monitoring Well Total Depths and Producing Aquifer

Former Atlas Missile Site No. 7, Vernon, Texas

Monitoring Wells	TOC Elevation msl (feet)	Hydro-Stratigraphic Unit	Total Depth bgs (feet)
MW-06	1365.07	Seymour	31.5
MW-07	1370.88	Seymour	23.53
MW-08	1365.94	Seymour	25
MW-09	1366.22	San Angelos	220

Morrison Knudsen, ESI Final Report, January 2001

It was concluded in the Morrison Knudsen Final ESI Report that two hydrostatic units are intersected by the monitoring wells installed at this site. One unit is the Shallow Pleistocene age Seymour Formation and the other is the Permian age San Angelos Formation. Hydrostatic water measurements were taken from the three-groundwater monitoring wells located within the Seymour formation, this indicated the aquifers gradient is to the northwest.

The deep bedrock aquifer is intersected by only one groundwater-monitoring well (MW-09). This one groundwater-monitoring well is not adequate to determine actual groundwater gradient for the San Angelos aquifer.

This interpretation is supported by the information gathered during the performance of this ESI Phase II. Prior to redeveloping each groundwater monitoring well, the static water level in each well was measured with an electric water level indicator to 1/100 foot. Measurements were taken from pre-established top of casing identification marks at the top of each well casing. **Table 2.5** illustrates the static water level measurements prior to redevelopment. The static water level measurements were recorded on the groundwater sampling form for each well (**Appendix C**).

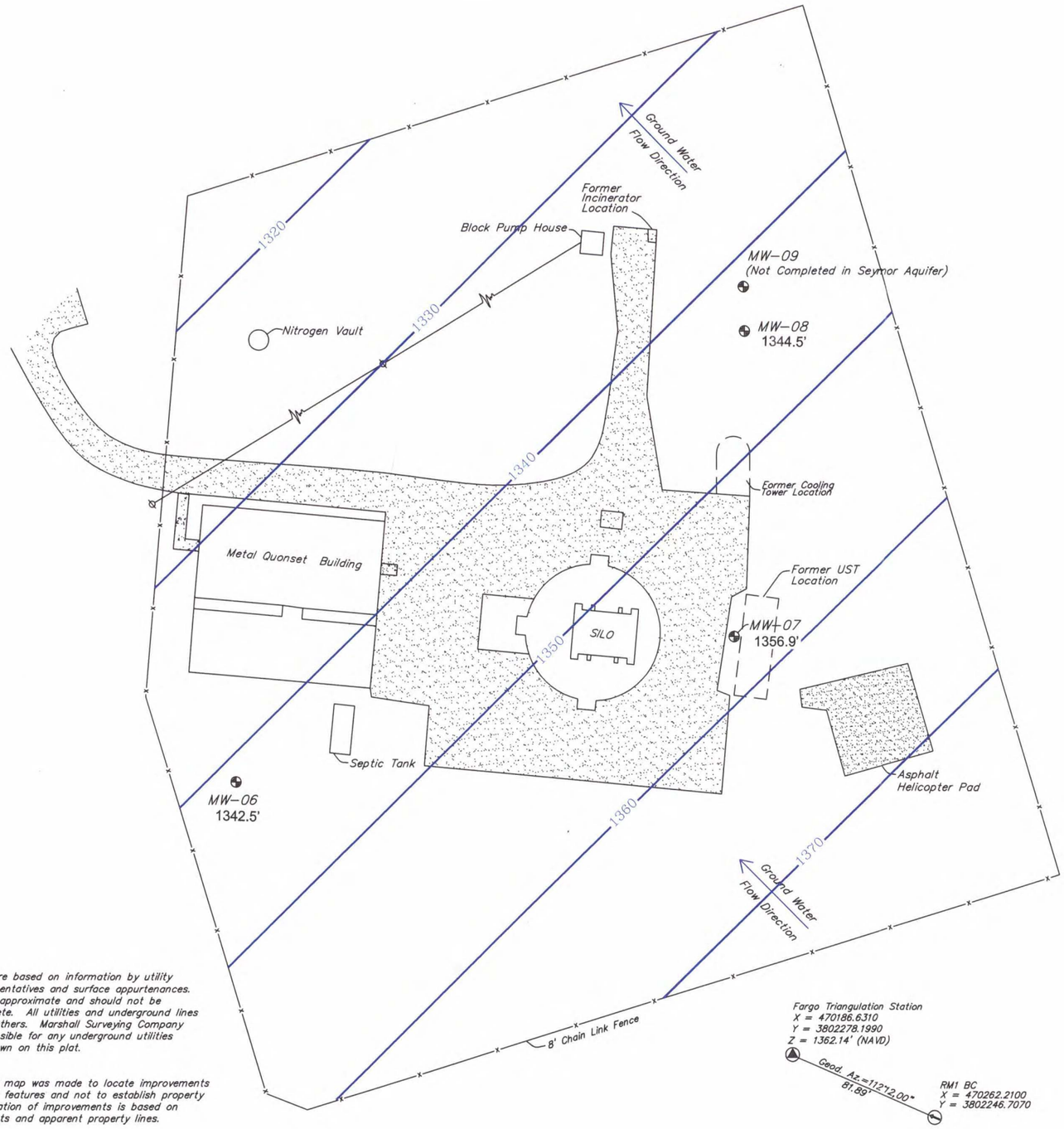
Table 2.5

Static Water Level Measurements

Monitoring Wells	TOC Elevation msl (feet)	Static Water Elevation msl (feet)	Hydro-Stratigraphic Unit	Static Water Depth bgs (feet)
MW06	1365.07	1342.53	Seymour	22.54
MW07	1370.88	1356.90	Seymour	13.98
MW08	1365.94	1344.49	Seymour	21.45
MW09	1366.22	1344.15	San Angelos	22.07

ESI Phase II, DEMS, September 2001

A contoured potentiometric surface (water table) of the Seymour aquifer, based upon static water level measurements taken prior to redevelopment, is included as **Figure 2**. Results confirm groundwater gradient direction for the Seymour formation is to the northwest.



N

0 15 30 60
Scale In Feet

LEGEND

- Fence Line
- Overhead Electric
- Power Pole
- Man Hole
- Control Monument (Fargo)
- Reference Mark
- Monitoring Well Location
- Asphalt
- Concrete
- 1350 Contour

NOTES

Utility locations are based on information by utility companies, representatives and surface appurtenances. Location may be approximate and should not be considered complete. All utilities and underground lines were located by others. Marshall Surveying Company will not be responsible for any underground utilities shown or not shown on this plat.

This topographical map was made to locate improvements and topographical features and not to establish property corners. The location of improvements is based on existing monuments and apparent property lines.

Surveying & Mapping By
MARSHALL SURVEYING COMPANY
P.O. Box 1221 Seminole, Oklahoma 74868 (405) 382-4488
CA 2261 LS Expires June 30, 2003

FIGURE 2

CONTOURED POTENTIOMETRIC SURFACE SEYMOR AQUIFER (AMS No. 7)

CONTRACT No. DACA 56-01-D-2005 TASK ORDER No.1

WILBARGER COUNTY, TEXAS

US ARMY CORPS OF ENGINEERS
TULSA DISTRICT
1645 SOUTH 101st EAST AVENUE, TULSA, OKLAHOMA

DEERINWATER ENVIRONMENTAL MANAGEMENT SERVICES, INC.

Drawn By: JLA & SRR	Checked By: JBM	Date: DECEMBER 4, 2001
SHEET 1 OF 1	Job No. 47401	Revised:

3.0 Previous Environmental Investigations

3.1 Previous Environmental Investigations

Previous investigative efforts consisted of a Preliminary Assessment and Site Inspection (PA/SI) conducted in 1995, demolition and closure of various DOD structures in 1999, and an ESI performed in 2000.

The PA/SI was conducted in 1995 by the USACE, Tulsa District as part of the DOD Environmental Restoration Program. The primary objective of the PA/SI was to determine if there was a release or potential of hazardous substances due to past DOD usage of the site.

The PA included gathering and reviewing existing site information, interviews of former site personnel, DOD files, published geological/hydro-geological reports, and aerial photography. The completed PA identified the following sources for potential releases as:

- On-site storage tanks used to provide fuel for electrical generators and incinerator.
- Fuels and oils used for equipment maintenance, and
- The hydraulic system used to operate the silo launch bay doors.

The SI that followed the PA was to determine if site soils or groundwater contamination had occurred as a result of past DOD activities. SI activities consisted of performing the following:

- Collection of surface soil samples
- Installation of three shallow boreholes for surface and subsurface soils data collection.
- Installation of a shallow groundwater monitoring well and one deep groundwater-monitoring well to assess groundwater quality.
- Collection of water samples from the missile silo, groundwater monitoring wells, and on-site domestic water well.

3.1.1 PA/SI Findings and Recommendation - USACE (1995)

All references to field operations, analytical results and conclusions given in this report

were taken from the Morrison Knudsen January 2001 Expanded Site Investigation Report. Original data was not provided to DEMS. Morrison Knudsen reported that no Volatile Organic Compounds (VOCs) were detected in the soil or groundwater and all metals detected were stated as within the acceptable background ranges. However, total recoverable petroleum hydrocarbon (TRPH) and several Semi-volatile Organic Compounds (SOVCs) were detected in soils and groundwater samples. Bis (2-ethylhexyl) phthalate was the only SVOC detected in soils. This contaminate was detected in all three boreholes and at various depths ranging from the surface to 25 feet below ground surface (bgs). SVOCs detected in groundwater samples included Bis(2-ethlhexyl) phthalate, benzoic acid, di-n-octylphthalate, and phenol.

It was concluded in the 1995 USACE SI report, as represented in the Morrison Knudsen January 2000 report, that Bis(2-ethlhexyl) phthalate is commonly added to plastics to enhance flexibility. Therefore the presence of this compound in soil samples and groundwater was probably due to leaching of this compound from sampling equipment and rubber gloves used in sampling, rather than a result of former DOD activities. The USACE SI 1995 report also stated that the other SVOCs detected in groundwater were known laboratory contaminants and were thought to be introduced during the laboratory analysis procedures. The Morrison Knudsen January 2001 report did not provide any conclusions as to the potential source of the detected TRPH. The findings of the SI report recommended no further action was required at this site. The two monitoring wells installed during the 1995 PA/SI were plugged and abandoned in May of 1998 by the USACE.

In March 1999, the TNRCC completed its review of the 1995 SI report and responded with a Notice of Deficiency to the USACE, Tulsa District, disagreeing that the presence of SVOC contaminants were not field sampling or laboratory contamination, and that potential impacts to the upper and lower aquifers had not been properly evaluated. The TNRCC review and comments prompted the USACE, Tulsa District to review the data collected during the 1995 SI. The USACE concluded that the data collected was

questionable due to various quality control issues. This prompted the USACE, Tulsa District to contract an ESI, which was performed by Morrison Knudsen in 2000.

3.1.2 Expanded Site Investigation, Morrison Knudsen (MK 2001)

Morrison Knudsen conducted all field ESI activities in 2000. MK presented their findings for the AMS No. 7 ESI to the USACE in a final report dated January 2001.

The following is a brief description of field activities performed during the 2000 ESI.

- Collection of surface soil samples for chemical analysis.
- Drilling and continuous coring of three shallow boreholes. Boreholes were drilled to the top of the alluvial/bedrock contact. Soil samples were collected for chemical analysis at 5-foot intervals within the vadose zone at each borehole and at the underlying alluvial/bedrock, contact and soils were lithologically described.
- Drilling and continuous coring of one deep borehole. The deep borehole was drilled to 210 feet bgs.
- Subsequent installation of monitoring wells at each borehole location. Well development and groundwater sampling at each well following well installation.

3.1.3 MK (2001) ESI Surface Soil Sample Results

In the MK ESI 2001 final report, all analytical results, except detected metal concentrations in soils, were compared to the TNRCC RRS-II medium specific concentrations (MSCs) applicable to industrial activities **(Appendix G)**. All analytical results for detected metals in soils were compared to the Texas Specific Background Concentrations (TNRCC Interoffice Memorandum dated June 28, 2000) **(Appendix H)**.

No pesticides, herbicides or TRPH were detected in the surface soil samples collected.

Bis(2-ethlhexyl) phthalate were not detected in surface or subsurface soils during the ESI performed by MK. The absence of detectable levels of this compound suggest that the presence of this SVOC detected in the 1995 PA/SI samples were a result of laboratory cross contamination and not from previous DOD usage.

All laboratory results for metals in the soil were found to be less than TNRCC Texas Specific Background Concentrations, with the exception of lead and zinc located in the areas associated with the old incinerator, cooling tower, and underground storage tank (UST) locations.

Polychlorinated biphenyls (PCBs) were also detected in soil samples collected from areas near the incinerator, cooling tower, and UST locations. The detection of PCB contaminate is indicative of a prior release. However, PCB concentrations did not exceed the MSCs for inhalation, ingestion, and dermal contact, but do exceed the MSCs for groundwater protection. It was concluded in the MK ESI 2001 final report that because subsurface soil sample concentrations were non-detect for PCBs that the TNRCC groundwater protection criteria was met. **Table 3.3.1** lists the lead and zinc concentrations near the incinerator, cooling tower and former UST location.

Table 3.1.3

MK (2001) Surface Soil Results Metals

Sample Locations	**Lead**	**Zinc**
Incinerator		
SS08	152 mg/kg	102 mg/kg
SS09	19.3 mg/kg	45.6 mg/kg
SS10	10.4 mg/kg	18.8 mg/kg
Cooling Tower	.	
SS11	18.4 mg/kg	181 mg/kg
SS12	6.6 mg/kg	32.2 mg/kg
USTs		
SS13	22.2 mg/kg	44.3 mg/kg
SS14	14.5 mg/kg	11 mg/kg

Results taken from MK ESI report January 2001

3.1.4 MK (2001) ESI Subsurface Soil Sample Results

Subsurface soil samples were collected from three separate borehole locations (BH06, BH07 and BH08). All laboratory results for metals were less than the TNRCC Texas specific background concentrations. Several VOC and SVOC compounds were detected in the subsurface soil samples, with all results below the MSC values for inhalation, ingestion, dermal contact, and groundwater protection. **Table 3.1.4** lists the subsurface soil sample results.

Table 3.1.4

MK (2001) Volatiles/Semivolatile Organics Results

Suite/Compound	Borehole BH06				Borehole BH07		Borehole BH08				
	S-05	S-10	S-18	S-76	S-05	S-10	S-05	S-10	S-15	S-18	S-80
VOC (ug/kg)											
Acetone	41.2	--	16.1	34.6	--	--	52.2	26.4	62.5	27.8	26.7
Methylene Chloride	44.0	51.0	32.7	--	21.1	25.2	26.7	30.5	35.8	34.6	20.5
Toluene	--	--	--	--	3.96	--	--	--	--	--	--
Trichloroethene (TCE)	--	--	--	--	--	--	--	--	--	36.7	--
1,2,4-Trimethylbenzene	--	--	--	--	2.08	--	--	--	--	--	--
Xylenes	--	--	--	--	4.48	--	--	--	--	--	--
VOC (ug/kg)											
Pentane	ND	ND	ND	ND	12.5J	ND	ND	ND	ND	ND	ND
SVOC (ug.kg)											
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	15J	ND	ND	ND	ND	ND

Results taken from MK ESI report January 2001
S-05 – sample ID denoting depth (in ft. bgs)
-- Compound not detected above MDL
ND – Non-Detect
J – estimated value

3.1.5 MK (2001) ESI Groundwater Sampling Results

Several VOC and SVOC compounds were detected in the groundwater samples but were below the MSC groundwater values with the only exception being Trichloroethene (TCE) with a concentration of 0.140 mg/l from monitoring well MW08, which exceeded the MSCs for the TNRCC administrative code for public drinking water of .005 mg/l. **Table 3.1.5** lists all detected analytes for the monitoring well groundwater samples.

Table 3.1.5
MK (2001) Organic Compounds, Metal and Inorganics Detected in Groundwater

Suite/Compound	Seymour Aquifer			San Angelos Aquifer
	MW06	MW07	MW08	MW09
VOCs (ug/l)				
1.1-Dichloroethylene	--	--	0.3	--
cis-1,2-Dichloroethylene	--	--	30	--
trans-1, 2-Dichloroethylene	--	--	2.8	--
Trichloroethylene (TCE)	--	--	**140**	--
VOC tics (ug/l)				
Acetone	--	--	8.7	--
Chloroform	--	--	0.5	--
4-Isopropyltoluene	--	--	0.1	--
SVOC tics (ug/l)				
Di(2-ethylhexyl)phthalate	--	--	1.0J	1.3J
Metals (ug/l)				
Antimony	--	--	1.0	--
Barium	200	410	320	260
Chromium	12	15	8.3	1.3
Copper	7.9	10	4.1	4.3
Lead	14	6.8	--	--
Nickel	12	18	8.7	100
Inorganics (mg/l)				
Fluoride	0.09	0.6	0.6	--
Nitrate	9.5	--	0.5	0.7
Nitrite	0.01	--	--	--

Results taken from MK ESI report January 2001
-- Compound not detected above MDL
J – estimated value

All reports referenced are on record and available for review at USACE, Tulsa District Office.

4.0 Field Investigation Activities

4.1 ESI Phase II Field Activities Overview

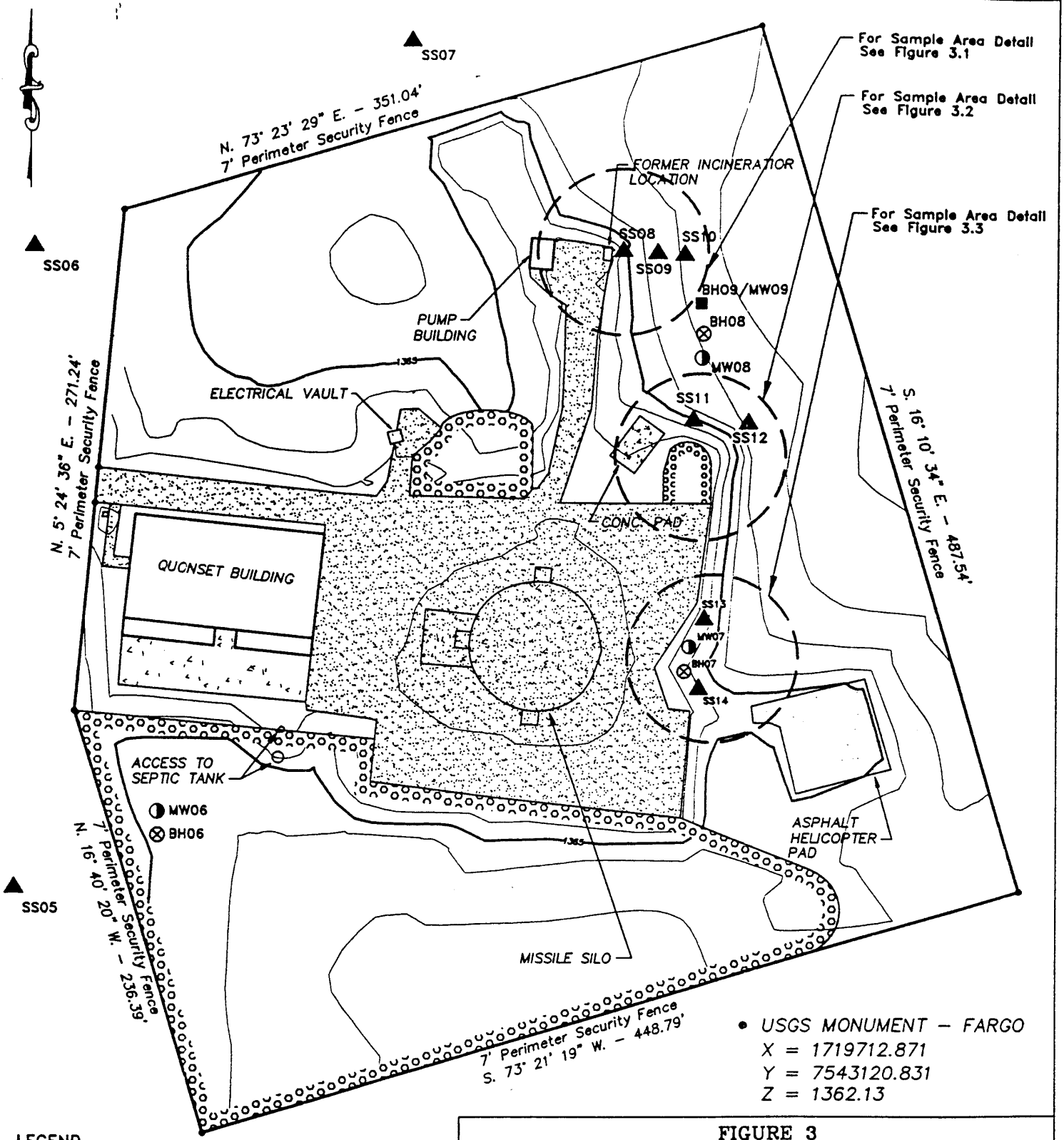
AMS No. 7 - Expanded Site Investigation, Phase Two Activities

- Collection of 65 surface samples analyzed for the eight (8) RCRA metals, zinc, and PCBs to further define the lateral extent of existing soil contamination and to establish actual background metal concentrations.
- Redevelopment of four existing groundwater monitoring wells, stabilization, well purging, collection of GW samples, analyzing of eight (8) RCRA metals, zinc, VOCs, SVOCs, Pesticides/PCBs, Herbicides, and TPH.
- Profiling, transportation and disposal of the Investigative Derived Waste (IDW).

Photographic documentation of field activities are located in **Appendix A.** A large-scale map detailing monitoring well locations, previous soil sample locations, current sampling locations, and major site features are included as **Appendix J**.

4.1.1 Surface Soil Samples

Various types of contamination were identified in the MK (2001) ESI final report. Soil samples taken from the areas of the incinerator, cooling tower, and UST indicated concentrations of lead and zinc potentially above acceptable background levels. Low levels of PCBs were also detected from soil samples collected near the incinerator, cooling tower, and UST. The PCBs results are indicative of a past release. This ESI Phase II identified these previous areas of concern that required further investigation. **Figures 3** shows the previous ESI sample locations (MK 2001) and the areas where additional surface soil sampling occurred during this ESI Phase II. **Figure 3.1** is a detailed map covering the area surrounding the former site of the incinerator. It includes the previous sampling locations (MK 2001) and new sample locations for this ESI Phase II, delineated by ten (10) foot square grids. **Figure 3.2** is a detailed map covering the area around the former site of the cooling tower. It also includes previous sampling locations and new sample locations for this ESI Phase II, delineated by ten (10) foot square grids. **Figure 3.3** is a detailed map covering the area surrounding the former UST site, which was removed during previous site activities. It includes the previous sampling locations and new sample locations used for this ESI Phase II, delineated by ten (10) foot square grids.



LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- BORE HOLE/MONITORING WELL LOCATIONS (MK, 2000)
- MONITORING WELL LOCATIONS (MK, 2000)
- BORE HOLE LOCATIONS (MK, 2000)
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3

D•E•M•S

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
SAMPLE LOCATIONS
Vernon, TX

DESIGNED BY	E. PENN	01/28/02	CHECKED BY	J. PIONESSA	01/28/02
DRAWN BY	G. FLICK	01/28/02	APPROVED BY	J. PIONESSA	01/28/02

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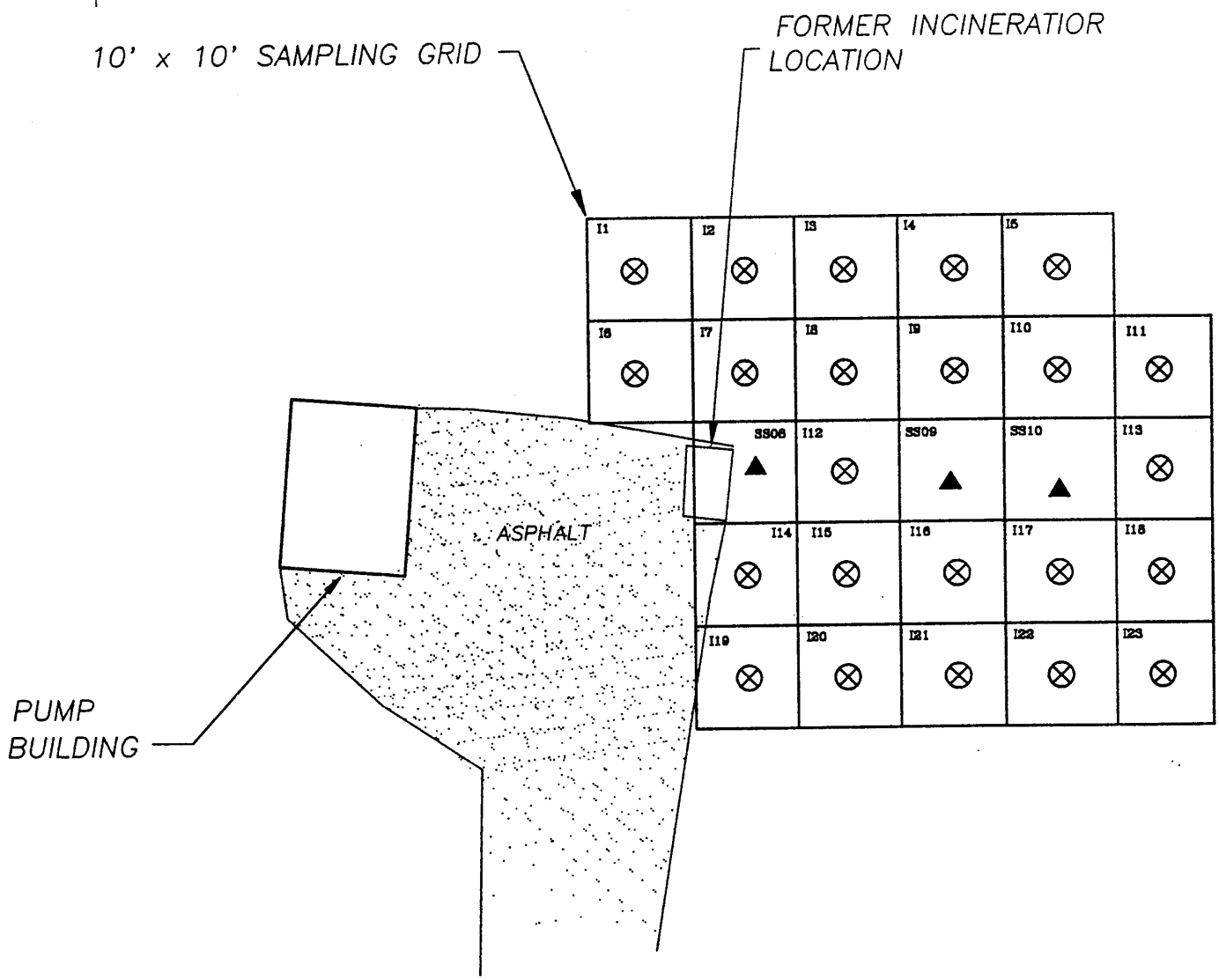


Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- BORE HOLE/MONITORING WELL LOCATION
- MONITORING WELL LOCATION
- ESI (DEMS, 2001) Surface Soil Sample
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

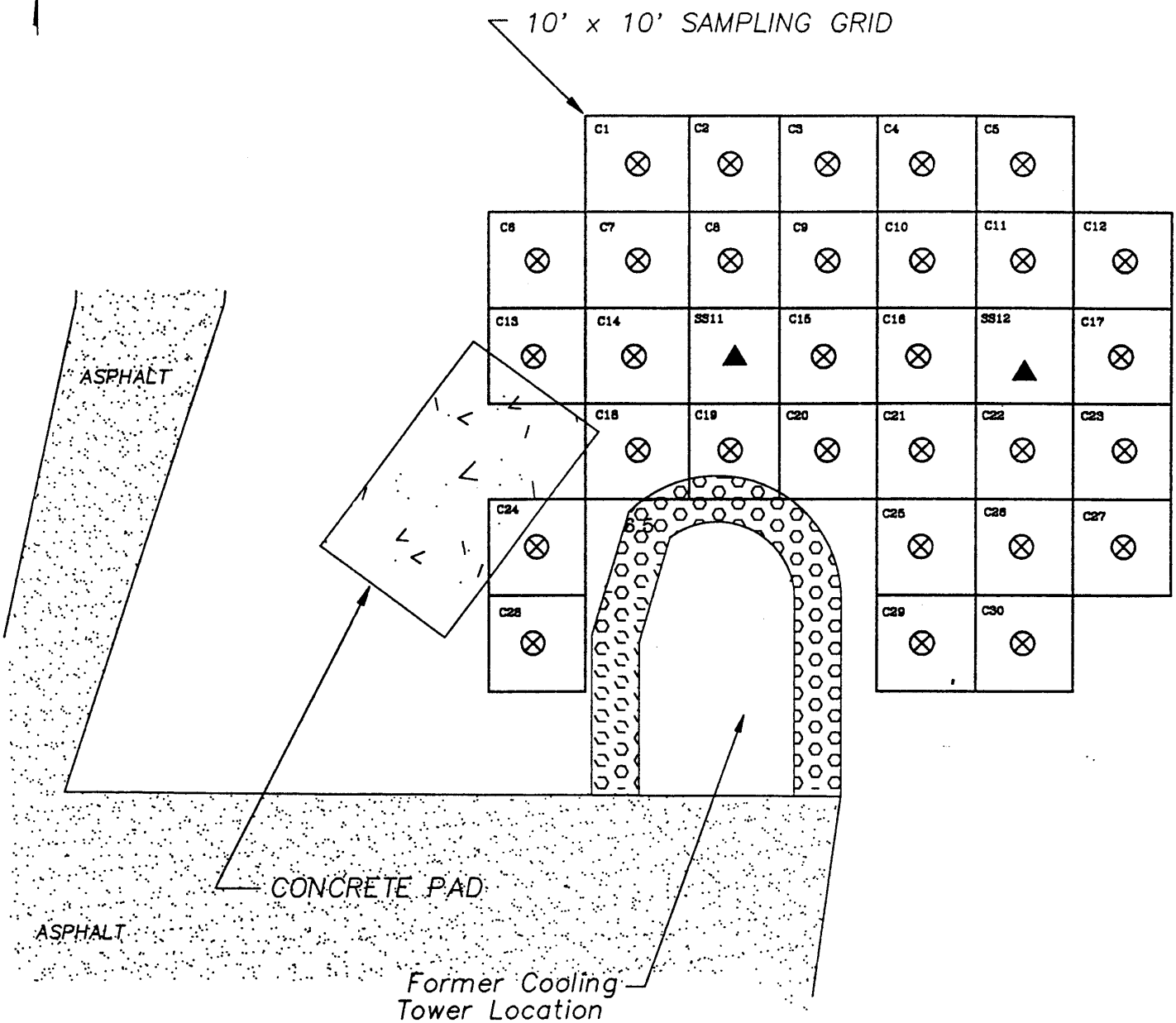
FIGURE 3.1

D•E•M•S

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Composite Sample Locations
Former Incinerator Location

DESIGNED BY	E. PENN	12/13/01	CHECKED BY	J. PIONESSA	12/13/01
DRAWN BY	G. FLICK	12/13/01	APPROVED BY	J. PIONESSA	12/13/01
SCALE: NO SCALE	DRAWING NO. 001		SHEET NO. 1 of 3	REVISION NO. 00	



Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- BORE HOLE/MONITORING WELL LOCATION
- MONITORING WELL LOCATION
- ESI (DEMS, 2001) Surface Soil Sample
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3.2

D•E•M•S

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Composite Sample Locations
Former Cooling Tower Location

DESIGNED BY	E. PENN	12/13/01	CHECKED BY	J. PIONESSA	12/13/01
DRAWN BY	G. FLICK	12/13/01	APPROVED BY	J. PIONESSA	12/13/01
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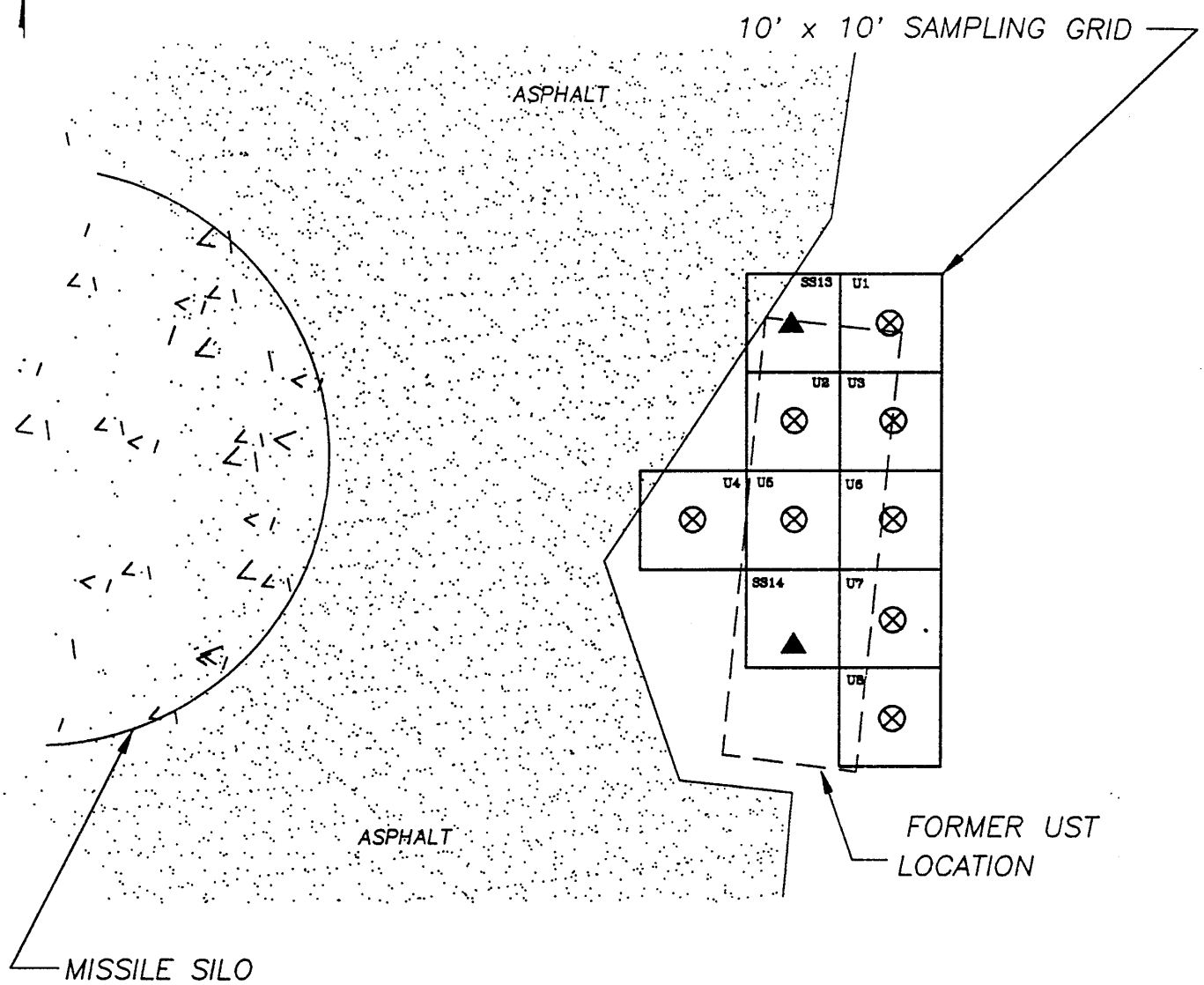


Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- BORE HOLE/MONITORING WELL LOCATION
- MONITORING WELL LOCATION
- ESI (DEMS, 2001) Surface Soil Sample
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3.3

D•E•M•S

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Composite Sample Locations
Forner UST Location

DESIGNED BY	E. PENN	12/13/01	CHECKED BY	J. PIONESSA	12/13/01
DRAWN BY	G. FLICK	12/13/01	APPROVED BY	J. PIONESSA	12/13/01
SCALE: NO SCALE	DRAWING NO. 003		SHEET NO. 3 of 3	REVISION NO. 00	

Sixty-one soil-sampling locations were identified for this ESI Phase II. The sample locations were laid out in 10 ft. by 10 ft. grids using a 100 foot tape measure, wooden stakes, and string. Each grid was individually marked with a flag recording its unique grid number. Each grid number was assigned a unique sample identification number (see Table 5.1, Section 5 of this report).

In addition to the sixty one (61) composited grid samples, four discrete background soil samples were collected. Each background soil sample was analyzed for the eight (8) RCRA metals, zinc, and PCBs. The background sampling locations for the background soil samples are shown on the detailed site map **Appendix J**.

4.1.2 Sample Collection Methods – Surface Soils

Each individual grid was represented by one composite soil sample. The composite sample was comprised of five (5) discrete samples taken from different locations within each grid. Each grid was divided into quarters, one sample was taken from each quarter and from the center. This material was collected from the top six (6) inches of the surface soils and composited as a representative sample for that grid. The four background soil samples were collected as discrete samples from the top six (6) inches of the surface soils. Samples collected were free of debris, rocks, and vegetation. Each sample was collected using a stainless steel trowel or stainless steel core barrel, which was decontaminated between each sample collection. Soil sampling collection logs were prepared for each sample collected, describing soil type, sampled interval, sample identification numbers and corresponding grid numbers, dates and times, field screening information, and analysis requested (see **Appendix B**). Each sample was labeled and placed into the appropriate sample containers as specified by the laboratory. Sample containers were bubble wrapped and placed in padded coolers with ice to lower the temperature to 4 degrees C. A chain of custody for each sample was prepared documenting a unique sample identification number, date and time of collection, analysis requested, and identity of the person collecting each sample. Each completed chain of custody was placed in the shipping cooler. The coolers were sealed with custody seals

and secured for shipping. Sampling locations were subsequently staked with pin flags or survey laths and clearly marked with each unique grid number or sample ID number. The staked sampling locations were then surveyed by a licensed survey company.

4.1.3 Groundwater Well Re-development

The existing groundwater wells at AMS No. 7 were redeveloped as required in the approved work plan and scope of work (SOW). Well development was accomplished using a submersible pump. Originally DEMS proposed that each well be surged before and between periods of pumping. Surging was not used during the redevelopment process of MW06, MW07, and MW08. After obtaining current static water levels, it was determined that the total casing volume was very small and the top of the static water column was well below the top of the screened interval in each well. It was recommended in the field and agreed to by the USACE field representative on site, that surging within the screened interval would not be completed due to the potential for damaging the screen. Instead, redevelopment of these three wells was accomplished with pumping only. All three wells were redeveloped using a 12-volt DC submersible electric pump. Both MW07 and MW08 pumped dry during redevelopment and exhibited very slow recharge rates. It was proposed in the approved work plan that redevelopment of MW09 would include a sand bailer to remove accumulated fill from the casing. A check of total well depth indicated no measurable fill had accumulated in this well. Redevelopment proceeded with pumping only. MW09 was redeveloped using a three quarter horsepower, 220-volt, three-inch diameter, submersible electric pump.

During well redevelopment activities, various water quality parameters were measured and recorded. These parameters included pH, temperature, conductivity, and turbidity. This information was then recorded on the Monitoring Well Development/Purging logs located in **Appendix C**.

Well redevelopment requires the following criteria be met:

- Minimum removal of three (3) times the standing volume in the well casing plus saturated annulus,
- Sediment thickness remaining in the well is less than 1 percent of the screen length (0.1 foot for screens 10 feet long).

- Measured water quality parameters are stabilized. Stabilization is reached after all parameters are stabilized for three successive readings. Three successive readings should be within plus or minus 0.2 for pH, plus or minus 1 degree Celsius for temperature, plus or minus 3% for conductivity, and plus or minus 10% for turbidity.

All instruments used to measure water quality parameters, were calibrated twice daily. The calibration results are recorded on the Calibration Logs located in **Appendix D**.

All of the criteria noted above were achieved except in the following wells:

- MW07
- MW09

In MW07 three (3) times the standing volume in the well casing plus saturated annulus calculated to only 8.83 gallons. This well pumped dry very easily and exhibited a very slow recharge rate. Development continued over a two day period with just over two well volumes, being recovered. Parameters were checked between each recharge event. All water quality parameters had stabilized, with the exception of turbidity, which was still dropping. A substantial decrease in turbidities had occurred during the two-day development period. Beginning turbidities that were above 990 ntu were reduced to below 15 ntu. Due to the extremely slow recharge rate of this well, the significant improvement in turbidity, and the stabilization of all remaining parameters, this well was accepted as developed.

MW09, the deep well, had a calculated three well volumes of 390 gallons including filter pack. This well pumped dry after producing only 142 gallons, approximately one well volume, and exhibited a very slow recharge rate. After initially pumping dry, MW09 was allowed to recharge for fifteen (15) hours. Additional pumping only recovered 60 gallons of water. The last three sets of parameter readings had almost reached stabilization. Turbidity which was above 990 ntu during the original well development had fallen to 7.59 ntu. Due to the extremely slow recharge rate of this well, the significant improvement in turbidity, and the near stabilization of all remaining parameters, this well

was accepted as developed. Per the approved work plan, all wells were then allowed a stabilization period of 10 days before purging and sampling.

4.1.4 Low Flow Groundwater Sampling Activities

Before the start of groundwater sampling activities, plastic sheeting was placed on the ground surrounding each well. The plastic sheeting provided a clean work area, and prevented any cross contamination to sampling equipment. The air in the breathing zone and well casing was checked with a Photo Ionization Detector (PID) each time a well cap was removed to measure water level or collect a sample. No concentrations of organic vapors were recorded above background levels. All air-monitoring results are recorded on the Monitoring Well Sampling Collection Log for each well (**Appendix E**).

Purging and sampling were achieved using the Low-Flow Minimal Drawdown technique to minimize aeration and agitation of sediments in the well and formation. This sampling technique is based on parameter stabilization, not the number of well volumes removed. The Low Flow technique used in sampling the AMS No. 7 site is described below:

Low-flow ground water sampling was accomplished using a Sample Pro portable micro purge positive displacement bladder pump with Teflon tubing. Two pumps were used for this sampling event. Pumps were deconed immediately after removal and prior to placement into each monitoring well. The Teflon tubing used for each monitoring well was purchased new and only used once. Because of the very low well volumes in each well and the history of the wells pumping dry, all pumps were placed near the bottom of each well. Care was taken not to touch the bottom of the well with the bladder pump, due to the potential of disturbing well sediments. After placing the pump, each well was allowed to sit overnight to stabilize before purging or sampling. Waiting overnight allowed the well temperature and any disturbed sediments to stabilize. During well purging, flow rates were measured every two to three minutes using a graduated cylinder. This allowed for the maximum flow rate of <0.5 L/min to be maintained during the purging and stabilization process.

After purging and stabilization, ground water quality parameters were monitored in the field (real time) every 2 to 3 minutes during purging. These results were taken from an inline flow cell and field turbidity meter and recorded on the groundwater sampling forms for each individual well. Water quality field parameters used to indicate stabilization include temperature, pH, specific conductivity, turbidity, and dissolved oxygen. Stabilization was demonstrated with three successive field readings of temperature within +/- 0.5 degrees Celsius, +/- 0.01 pH, +/-3% specific conductivity, turbidity, and dissolved oxygen within +/- 10%. After the water quality parameters had stabilized within the EPA's recommended ranges, samples were collected. Sample collection occurred immediately after stabilization was established, regardless of well volumes removed. All readings obtained during purging, stabilization, and sampling information were recorded in the Monitoring Well Sampling Collection Log (**Appendix E**).

During Low-Flow purging and sampling, the water level within the well was monitored to ensure no excessive draw-down occurred. No excessive draw-down was observed in any of the wells sampled.

All instruments used to measure water quality parameters were calibrated twice daily. The calibration results are recorded on the Calibration Logs located in **Appendix D**.

4.1.5 Surveying and Mapping

All surface soil sample locations were surveyed upon completion of sampling activities. Horizontal coordinates were established relative to the Texas State Plane coordinate system. Surveys were connected to the coordinate system by third order, Class II control surveys. Horizontal coordinates were recorded to the nearest 0.1-foot. Survey coordinates for each sampling location and monitoring well location were recorded on a detailed site map, **Appendix J**.

Ground surface elevations were also shot at each location and recorded to the nearest 0.1 foot. Elevations will be referenced to the National Geodetic Vertical Datum of 1929

(NGVD of 1929) or the North American Vertical Datum, 1988 Adjustment (NAVD 88). Vertical surveys will be connected to datum by third order leveling. A licensed surveyor was used to perform the survey services.

4.1.6 IDW Waste Disposal

Waste generated during the ESI Phase II included decontamination water, monitoring well development water, and purge water. The water generated during he ESI was stored in a 500-gallon poly tank pending laboratory analysis.

Water sample results of the IDW confirmed the IDW to be non-hazardous. A licensed vacuum truck was used to remove the water from the poly tank and transported it to an Oklahoma Department of Environmental Quality licensed facility for disposal. All IDW transportation and disposal documentation is included in **Appendix F**.

5.0 Investigation Results

This section presents the results of this ESI Phase II. It includes the nature and extent of the contamination, and identifies the contaminants of potential concern (COPCs) in soils and groundwater.

5.1 Data Quality and Review

The laboratory analysis of the soil and groundwater samples collected during the ESI Phase II field activities underwent an independent third party data validation review. Reported undetected mercury in nineteen of the surface soil samples was qualified as unusable data due to unacceptably low method bias resulting in a 73% completeness for mercury in soils. All remaining data was determined to be 100% usable. Therefore the overall goal of 90% completeness has been met for data quality. The independent data validation review concluded that the analytical results generated during the ESI Phase II were of sufficient documented quality to determine the nature and extent of contamination. The data evaluated is adequate to assess the level of contaminates present for the purposes of risk assessment, determination of remedial alternatives, and/or further investigation. A copy of the Data Validation Report and all validated data is presented in **Appendix M**.

5.2 Surface Soils

A total of sixty-five (65) surface soil samples were collected and analyzed for the eight (8) RCRA metals, zinc and PCBs. All surface soil samples were collected from the upper six (6") inches of the surface soils. Sixty-one (61) of the samples were collected near areas of previous known releases based on prior site investigations. The remaining four soil sample locations were collected along the perimeter of the site boundaries to establish site soil background concentrations. **Figures 3.1, 3.2** and **3.3**, located in Section 4 of this report, address the specific surface areas sampled during this investigation. **Table 5.1**, below, details the surface soil sampling analytical results.

TABLE 5.1

Analytical Results For Surface Soil Samples

INCENERATOR

Grid #	Sample ID	Arsenic	Barium	Chromium	Lead	Zinc	PCBs	Units
I1	AMS07SS001	1.6	56.1	6.8	**34.4**	58.5	**.055**	mg/kg
I2	AMS07SS002	1.2	55.4	6.6	**34.9**	33.1	<.0200	mg/kg
I3	AMS07SS003	1.7	56.2	7.5	**16.2**	25.7	<.0200	mg/kg
I4	AMS07SS004	1.6	51.8	6.9	**10.6**	33.1	<.0200	mg/kg
I5	AMS07SS005	1.2	53.9	8.6	**10**	28	<.0200	mg/kg
I6	AMS07SS006	1.4	921	6.9	**104**	136	**.228**	mg/kg
I7	AMS07SS007	1.8	98	9.8	**288**	82.2	<.0200	mg/kg
I8	AMS07SS008	1.4	63.2	6.2	**38.4**	31.8	<.0200	mg/kg
I8	AMS07SS008QC	1.7	64.3	7.12	**39.4**	31.9	<.0200	mg/kg
I9	AMS07SS009	1.4	51.3	6.2	**15.3**	33.6	<.0200	mg/kg
I10	AMS07SS010	2.0	48.2	6.7	**14**	24.1	<.0200	mg/kg
I11	AMS07SS011	1.4	43.6	5.7	**10.4**	25	<.0200	mg/kg
I12	AMS07SS012	2.2	73.9	6.7	**64.5**	44.1	<.0200	mg/kg
I13	AMS07SS013	<1.000	47.9	5.1	**11.5**	24.6	<.0200	mg/kg
I14	AMS07SS014	1.6	73	9.4	**163**	88.4	<.0200	mg/kg
I15	AMS07SS015	1.4	84.6	8.3	**38.8**	62.4	<.0200	mg/kg
I16	AMS07SS016	<.969	73.6	7.6	**24**	40.1	<.0200	mg/kg
I17	AMS07SS017	<.978	49.2	5.7	**17.2**	22.3	<.0200	mg/kg
I18	AMS07SS018	.988B	46.1	5.1	**11.5**	27.1	<.0200	mg/kg
I18	AMS07SS018QC	<.956	43.1	6.2	**9.5**	29.2	<.0680	mg/kg
I19	AMS07SS019	1.4	55	7.3	**32.1**	35.3	<.0200	mg/kg
I20	AMS07SS020	1.6	73.4	7.2	**26.6**	33.6	<.0200	mg/kg
I21	AMS07SS021	NA	NA	NA	**NA**	NA	<.0200	mg/kg
I22	AMS07SS022	<.944	44.4	6.8	**21.9**	25.7	<.0200	mg/kg
I23	AMS07SS023	1.4	48.8	8.7	**12.2**	26.9	<.0200	mg/kg

COOLING TOWER

Grid #	Sample ID	Arsenic	Barium	Chromium	Lead	Zinc	PCBs	Units
C1	AMS07SS024	1.2	55.5	5.6	**6.6**	36J	<.0202	mg/kg
C2	AMS07SS025	<1.004	53.0	5.8	**4.6**	24.5J	<.0204	mg/kg
C3	AMS07SS026	1.0BJ	47.4	6.6	**4.0**	23.1J	<.0202	mg/kg
C4	AMS07SS027	1.2	43.8	6.9	**3.8**	21.2J	<.0202	mg/kg
C5	AMS07SS028	1.0BJ	36.8	6.3	**3.8**	50.6J	<.0202	mg/kg
C5	AMS07SS028QC	<.977	32.8	5.1	**3.3**	53.1J	<.0202	mg/kg
C6	AMS07SS029	1.2	89.8	7.2	**18.2**	89.4J	**.286**	mg/kg
C7	AMS07SS030	1.4	61.1	6.7	**9.3**	46.3J	<.0204	mg/kg
C8	AMS07SS031	1.0BJ	53.1	7.7	**4.8**	33.1J	<.0202	mg/kg
C9	AMS07SS032	1.2	46.9	7.3	**3.7**	21.1J	<.0202	mg/kg
C9	AMS07SS032QC	1.2	206	6.9	**3.7**	21.4	<.0202	mg/kg
C10	AMS07SS033	<1.033	41.1	5.4	**3.7**	19.8	<.0213	mg/kg
C11	AMS07SS034	<.962	32.5	3.5	**4.2**	17.9	<.0202	mg/kg
C12	AMS07SS035	1.2	38.8	5.8	**5.4**	50.1	**.082**	mg/kg
C13	AMS07SS036	2.3	97.1	11.3	**89.6**	221	**.395**	mg/kg
C13	AMS07SS036QC	1.8	98.6	11.6	**46.4**	216J	**.5J**	mg/kg
C14	AMS07SS037	1.9	96.3	13.4	**46.5**	131J	<.0206	mg/kg
C15	AMS07SS038	1.0BJ	47.4	6.4	**6.2**	52.2J	<.0202	mg/kg
C16	AMS07SS039	1.0BJ	53.5	6.7	**5.7**	46.5J	<.0202	mg/kg

Table 5.1 (continued)
COOLING TOWER

Grid #	Sample ID	Arsenic	Barium	Chromium	Lead	Zinc	PCBs	Units
C17	AMS07SS040	1.0BJ	40.8	7.0	**4.8**	67.5J	**.067J**	mg/kg
C18	AMS07SS041	1.6	80.5	9.8	**15.7**	144J	<.0204	mg/kg
C19	AMS07SS042	1.4	74.9	10	**13.9**	89.4J	.046	mg/kg
C20	AMS07SS043	1.4	69.2	5.8	**18.0**	76.8	<.0204	mg/kg
C21	AMS07SS044	1.0	58.3	6.7	**4.5**	28.0	<.0202	mg/kg
C22	AMS07SS045	1.2	42.5	5.2	**3.7**	19.0	<.0202	mg/kg
C23	AMS07SS046	<1.008	36.1	5.8	**5.0**	82.5	<.0202	mg/kg
C24	AMS07SS047	1.6	99.3	10.4	**54.0**	365.0	**.115**	mg/kg
C25	AMS07SS048	1.6	66.5	6.4	**7.0**	34.5	<.0202	mg/kg
C26	AMS07SS049	1.4	62.8	7.8	**5.8**	43.4	**.298**	mg/kg
C27	AMS07SS050	<.972	39.2	6.2	**7.3**	120.2	<.0202	mg/kg
C27	AMS07SS050QC	<.996	33.1	5.0	**6.6**	108J	<.0202	mg/kg
C28	AMS07SS051	1.8	84.5	10.1	**58.6**	346.1	<.0202	mg/kg
C29	AMS07SS052	1.8	74.1	7.0	**15.8**	66.1	<.0202	mg/kg
C30	AMS07SS053	1.4	61.1	9.1	**9.1**	67.3	.024	mg/kg

FORMER UNDERGROUND STORAGE TANK AREA

Grid #	Sample ID	Arsenic	Barium	Chromium	Lead	Zinc	PCBs	Units
U1	AMS07SS054	1.7	69.8	10.2	**12.9**	34.8	.045J	mg/kg
U2	AMS07SS055	1.5	69.9	12.0	**22.1**	40.4	**.170**	mg/kg
U3	AMS07SS056	1.4	66.2	9.1	**10.9**	38.5	<.1010	mg/kg
U4	AMS07SS057	1.3	82.3	12.3	**30.6**	34.8	<.1010	mg/kg
U5	AMS07SS058	1.4	71.8	10.3	**40.8**	35.4	<.1010	mg/kg
U6	AMS07SS059	1.8	55.8	7.0	**13.3**	26.8	<.1010	mg/kg
U6	AMS07SS059QC	1.9	59.1	8.4.0	**11.9**	26.4	<.1010	mg/kg
U7	AMS07SS060	1.8	75.9	12.3	**37.2**	48.2	**.065**	mg/kg
U8	AMS07SS061	1.0	64.4	7.0	**7.0**	30.8	<.0202	mg/kg

BACKGROUND

	Sample ID	Arsenic	Barium	Chromium	Lead	Zinc	PCBs	Units
	AMS07SS062	1.4	35.7	60.5	**3.3**	16.2	<.0202	mg/kg
	AMS07SS063	1 BJ	19.9	3.6	**1.7**	<9.56	<.0200	mg/kg
	AMS07SS064	<.990	26.3	3	**2.8**	10.5	<.0202	mg/kg
	AMS07SS065	<.990	27.5	4.6	**3**	11.1	<.0202	mg/kg

ND – Non Detect
NA – Not Available
J – Estimated
Bold/ Shaded – Exceeds the Screen Level for Groundwater Protection (GWP) RRS-II MSC

The highlighted lead and PCB concentration on the preceding table all exceeded the residential Groundwater Protection (GWP) levels for soils as listed on the RRS-II MSC found in **Appendix G**.

Only two surface soil samples detected metals other than the metals indicated above. Sample number AMS07SS035 located in Grid C12, detected mercury at 0.153 mg/kg. Sample number AMS07SS051 located in Grid C28 detected cadmium at 0.402 mg/kg. The mercury detected in sample number AMS07SS035 is below the MSC of 6.1 mg/kg

soils residential and 0.2 mg/kg for GWP residential. The cadmium detected in sample number AMS07SS051 is below the MSC of 1400 mg/kg soils residential and 0.5 mg/kg for GWP residential. **Table 5.2** below lists the RRS-II MSC screen levels for both soil GWP and residential, for the eight RCRA metals, zinc and PCBs.

Table 5.2

TNRCC RRS-II Residential and GWP Residential Screening Values Eight (8) RCRA Metals and Zinc

Analyte	GWP Screening Level mg/kg	Soil Residential Screening Level mg/kg
Arsenic	5	20
Barium	200	9100
Cadmium	0.5	1200
Chromium	10	53000
Mercury	0.2	6.1
Lead	1.5	500
Silver	18	460
Selenium	5	1300
Zinc	1100	5900
PCBs	.05	10

It is reported in the independent data validation report that undetected mercury in sample numbers AMS07SS025 through 032, SS036QC through 043, SS050, and SS050QC was qualified as unusable data due to unacceptably low method bias. This does not suggest that mercury should have been detected, only that the non-detect readings are bias low. This is probably due to soil matrix interference. Mercury had not been identified in previous site investigations as a COPC. Non-rejected mercury concentrations are below action levels for soils residential and GWP residential. Therefore mercury is not considered a primary COPC.

Only the detected concentration of lead and PCBs highlighted on **Table 5.1** exceeded any of the screening levels for both soils and GWP residential under RRS-II MSC found in **Appendix G.** No other analyite for soils exceeded screen levels for RRS-II MSC residential.

5.2.1 Comparison To Previous Site Investigations - Surface Soil Sampling

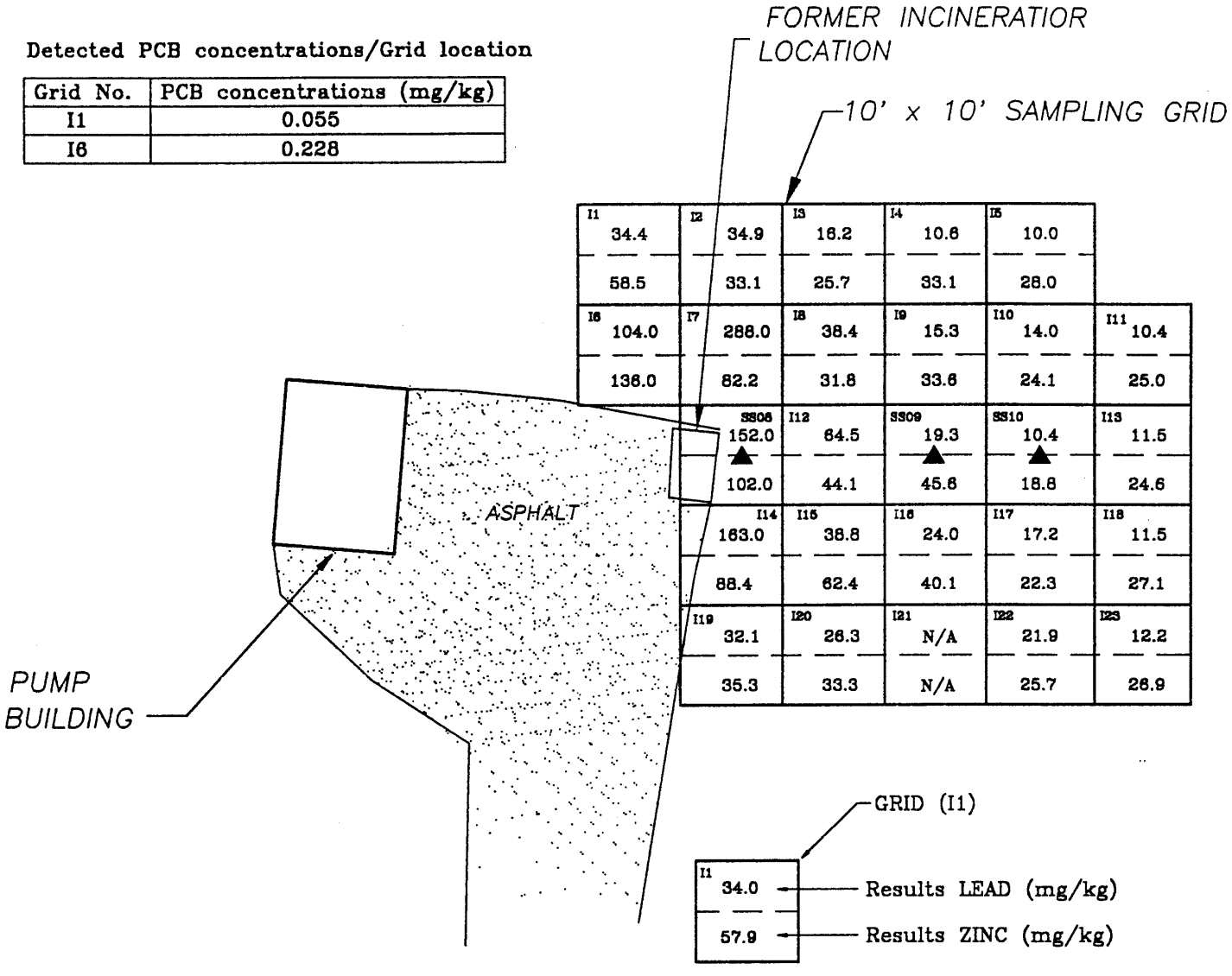
Previous surface soil analytical results, as presented in Section 3 of this report, indicated lead, zinc, and PCB contamination near the original locations of the incinerator, cooling tower, and UST. Analytical results for lead and zinc were compared, by MK in their ESI 2001 final report, to the Texas Specific Background Concentrations (Interoffice memorandum dated June 28, 2000). This memorandum lists background concentrations for lead at 15 mg/kg and zinc at 30 mg/kg. Several soil samples collected and analyzed during the MK ESI detected lead and zinc levels in excess of the Texas Specific Background Concentrations, causing MK to list them as primary COPCs. However, the Texas Specific Background Concentration levels of 15 mg/kg for lead and 30 mg/kg for zinc do not represent screening values or clean-up levels, but only suggested background values. The metal concentrations reported in the MK ESI final report should have been compared to MSC RRS-II soil screening levels for residential use of 500 mg/kg for lead, and 59000 mg/kg for zinc.

Analytical results from surface soil sampling conducted during this ESI Phase II did confirm elevated levels of lead, zinc, and some PCBs surrounding the incinerator, cooling tower, and UST. All three COPC maximum concentrations were below the MSCs RRS-II soil screening levels for residential use of 500 mg/kg for lead, 59000 mg/kg for zinc and 10 mg/kg for PCBs. **Figures 3.1A**, **3.2B**, and **3.3C** show the grid sampling locations for lead and zinc concentrations detected during this ESI Phase II investigation.

Lead, Zinc and PCB Background Concentrations			
	Average	High	Low
LEAD	2.7 mg/kg	3.3 mg/kg	1.7 mg/kg
ZINC	9.45 mg/kg	16.2 mg/kg	0 mg/kg
PCBs	<.0202 mg/kg	<.0202 mg/kg	<.0202 mg/kg

Detected PCB concentrations/Grid location

Grid No.	PCB concentrations (mg/kg)
I1	0.055
I6	0.228



Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

N/A – Laboratory Results Not Available

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3.1A

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Results Incinerator Sampling Grid
Vernon, TX

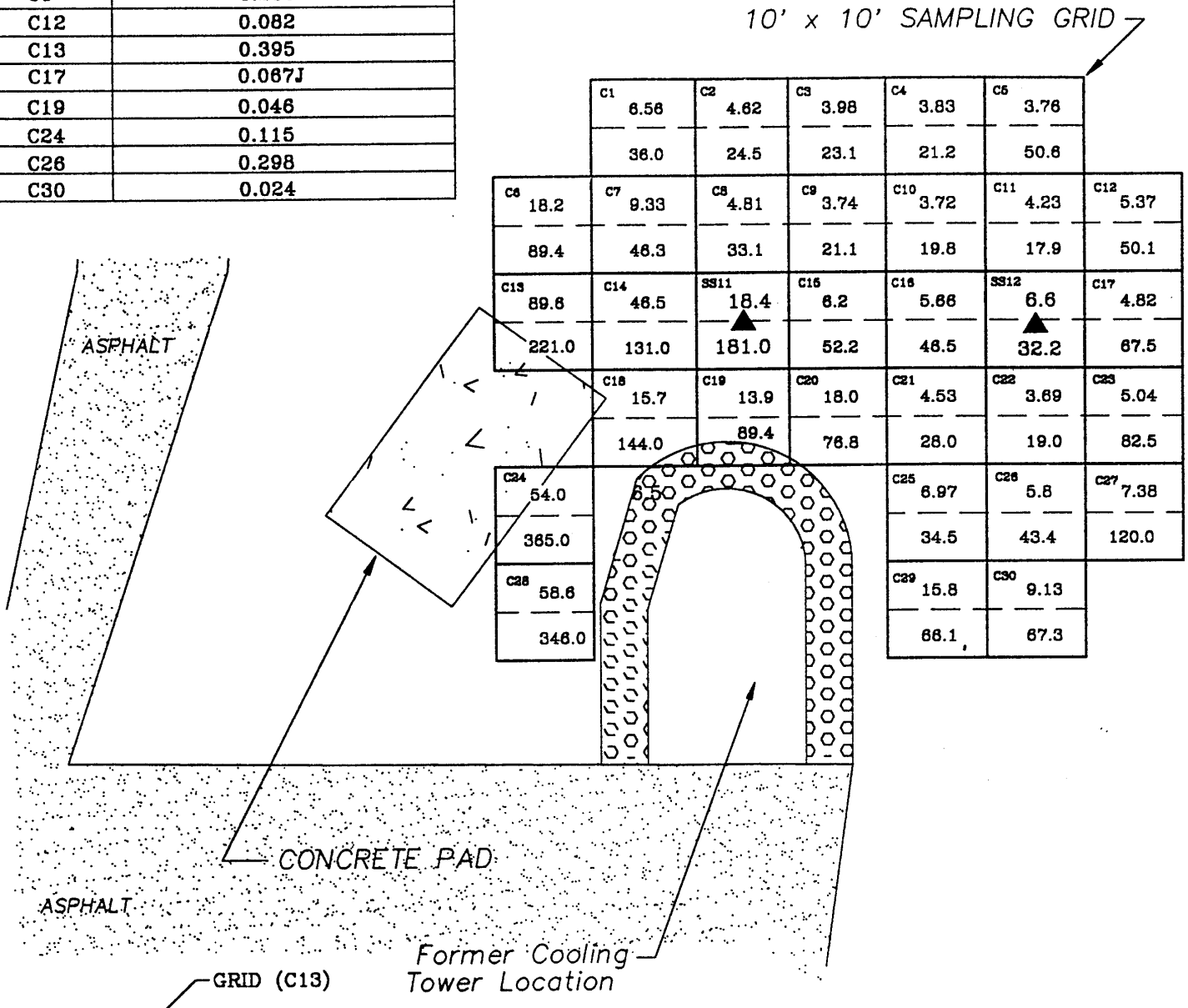
D•E•M•S

DESIGNED BY	E. PENN	01/29/02	CHECKED BY	J. PIONESSA	01/29/02
DRAWN BY	G. FLICK	01/29/02	APPROVED BY	J. PIONESSA	01/29/02
SCALE: NO SCALE	DRAWING NO. 001		SHEET NO. 1 of 3		REVISION NO. 01

Lead, Zinc and PCB Background Concentrations			
	Average	High	Low
LEAD	2.7 mg/kg	3.3 mg/kg	1.7 mg/kg
ZINC	9.45 mg/kg	16.2 mg/kg	0 mg/kg
PCBs	<.0202 mg/kg	<.0202 mg/kg	<.0202 mg/kg

Detected PCB concentrations/Grid location

Grid No.	PCB concentrations (mg/kg)
C6	0.286
C12	0.082
C13	0.395
C17	0.067J
C19	0.046
C24	0.115
C26	0.298
C30	0.024



Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3.2A

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Results Cooling Tower Sampling Grid
Vernon, TX

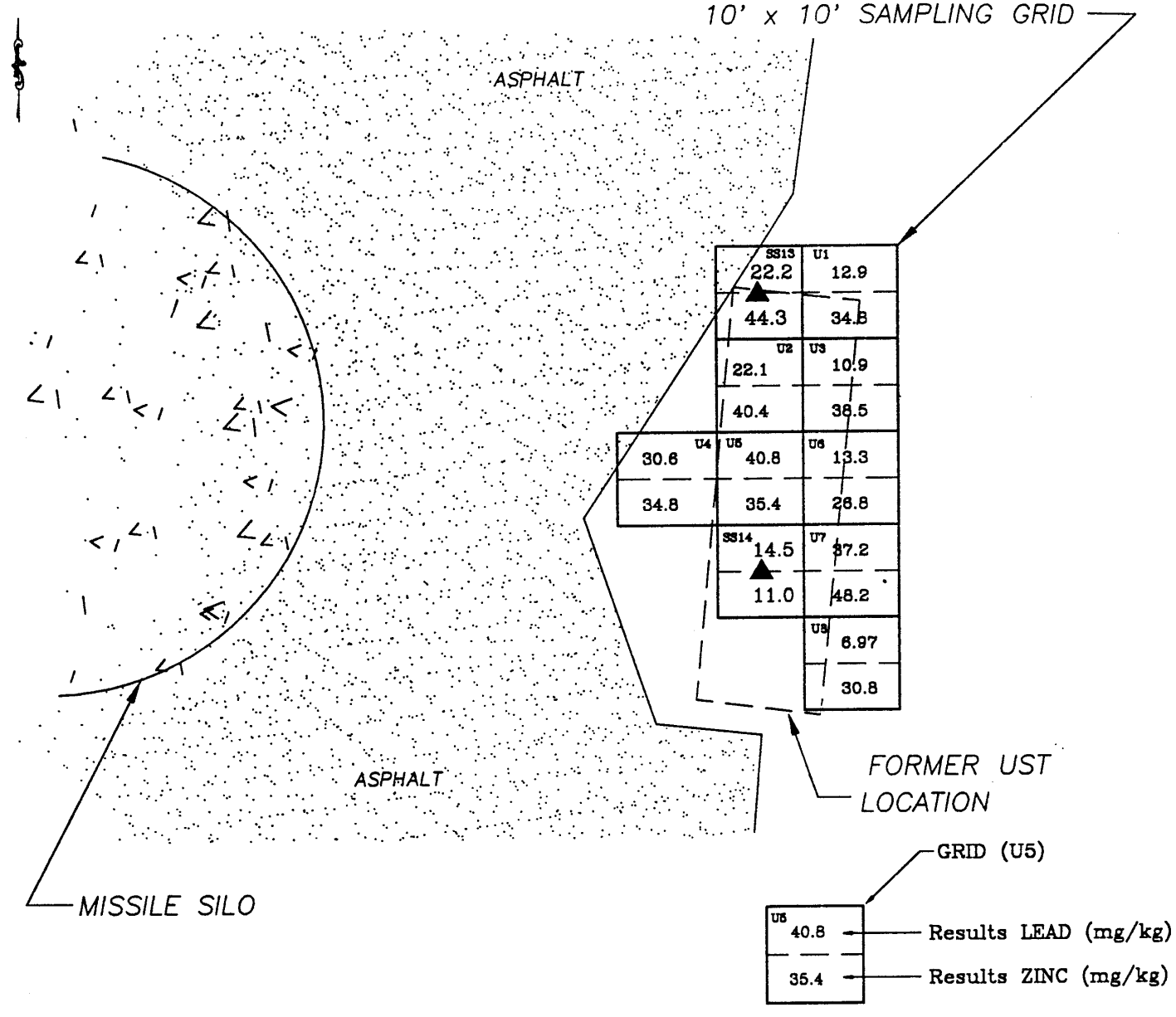
D•E•M•S

DESIGNED BY	E. PENN	01/29/02	CHECKED BY	J. PIONESSA	01/29/02
DRAWN BY	G. FLICK	01/29/02	APPROVED BY	J. PIONESSA	01/29/02
SCALE: NO SCALE	DRAWING NO. 002		SHEET NO. 2 of 3	REVISION NO. 01	

Detected PCB concentrations/Grid location

Grid No.	PCB concentrations (mg/kg)
U1	0.045J
U2	0.170J
U7	0.065

Lead, Zinc and PCB Background Concentrations			
	Average	High	Low
LEAD	2.7 mg/kg	3.3 mg/kg	1.7 mg/kg
ZINC	9.45 mg/kg	16.2 mg/kg	0 mg/kg
PCBs	<.0202 mg/kg	<.0202 mg/kg	<.0202 mg/kg



Note: Table 5.1 – Cross Reference Grid #'s With Sample ID #'s.

LEGEND

- ESI (MK, 2000) SURFACE SOIL SAMPLE LOCATIONS
- PERIMETER OF CLEAN FILL
- CONCRETE
- ASPHALT

FIGURE 3.3A

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

ATLAS MISSILE SITE No. 7
Results UST Sampling Grid
Vernon, TX

D•E•M•S

DESIGNED BY	E. PENN	01/29/02	CHECKED BY	J. PIONESSA	01/29/02
DRAWN BY	G. FLICK	01/29/02	APPROVED BY	J. PIONESSA	01/29/02
SCALE: NO SCALE	DRAWING NO. C03		SHEET NO. 3 of 3	REVISION NO. 01	

5.3 Groundwater

Goundwater samples were collected and analyzed for the eight (8) RCRA metals, zinc, VOCs, SVOCs, Pesticides/PCBs, Herbicides, and TPH from the four (4) groundwater monitoring wells on site. The water samples collected consist of three samples from the Seymour Aquifer (MW06, 07, 08) and one from the underlying San Angelos Aquifer (MW09). **Table 5.3**, below, details the monitoring well sampling and analytical results for all detected analytes.

Table 5.3

Groundwater Analytical Results Monitoring Wells

Analytical Suite/ Analyte	MW06	MW07	MW08	MW09	MW09QC
Metals (mg/l)					
Barium	.181	.336	.528	.049	.045
Cadmium	.002	<.0010	<.0010	.002	.003
Chromium	.011	<.0050	<.0050	.01	.014
Silver	.011	<.0050	<.0050	<.0050	<.0050
VOCs (mg/l)					
Cis-1,2- Dichloroethene	<.0020	<.0020	**.0514**	<.0020	<.0020
Trans- 1,2- Dichloroethene	<.0020	<.0020	**.0026**	<.0020	<.0020
Trichloroethene	<.0020	<.0020	**.139**	<.0020	<.0020
Toluene	<.0020	<.0020	.0028J	.0028J	.0025

ND – Non Detect
Bold – Results above MSCs Groundwater Residential RR Standard No. 2

No other VOC, SVOC or metals were reported above detection limits. Samples were also non-detect for Pesticides/PCBs, Herbicides and TPH.

5.3.1 Comparison To Previous Site Investigations - Monitoring Wells

5.3.1.1 Metals

Four metals were detected, barium, cadmium, chromium, and silver during the ESI Phase II. All metal concentrations are below MSCs for TNRCC RRS-II groundwater residential. All other metal results were below the laboratory detection limits. **Table 5.2.1** lists all metals above detection limits as reported in the MK ESI 2001 final report and detected during this ESI Phase II.

5.3.1.2 VOC's – Water Samples

Only four VOC's compounds were detected in water samples collected during this ESI Phase II. Cis-1,2- Dichloroethene, Trans-1,2- Dichloroethene, and Trichloroethene, were detected in MW08. Toluene was detected in MW08 and MW09. **Table 5.2.1** compares all detected concentrations for VOC compounds with the previous sampling events. This table also reports the MSCs action levels for each compound. These action levels were taken from the RRS-II-Res. (**See Attachment G**).

Trichloroethene is the only compound detected above the MSC action level for residential groundwater. Five VOC compounds, 1,1-Dichloreoethylene, acetone, chloroform, 4-Isopropyltoluene, and Vinyl Chloride identified in the MK ESI 2001 final report were not detected in this ESI Phase II.

5.3.1.3 SVOCs

The SVOC compound, Bis (2-ethylhexyl) phthalate was detected in MW08 as reported in the MK ESI 2001 final report. No SVOCs including Bis (2-ethylhexyl) phthalate were detected in the samples collected and analyzed during this ESI Phase II.

Table 5.3.1.3

Groundwater
Comparison Between MK Jan. 2001 Analytical Results with DEMS Dec. 2001 Results
All Detected Analytes

All units in – mg/l									
	MW06		MW07		MW08		MW09		
Analytical Suite/ Analyte	**MK Jan. 2001 Report**	**DEMS Dec. 2001 Report**	**MK Jan. 2001 Report**	**DEMS Dec. 2001 Report**	**MK Jan. 2001 Report**	**DEMS Dec. 2001 Report**	**MK Jan. 2001 Report**	**DEMS Dec. 2001 Report**	**MCS Action Levels Residential**
Metals									
Antimony	<.0002	N/A	<.0002	N/A	.001	N/A	<.001	N/A	.006
Barium	.200	.181	.410	.336	.32	.528	.260	.049	2.0
Cadmium	ND	.002	ND	<.001	ND	<.001	ND	.002	.005
Chromium	.012	.011	.015	<.005	.0083	<.005	.0013	.01	.1
Copper	.007	N/A	.010	N/A	.0041	N/A	.0043	N/A	1.3
Lead	.014	<.003	.0068	<.003	<.0005	<.003	<.0025	<.003	.015
Nickel	.012	N/A	.0182	N/A	.0087	N/A	.100	N/A	.73
Silver	ND	.011	ND	<.005	ND	<.005	ND	<.005	.18
VOCs									
Acetone	ND	<.05	N/D	<.05	.0087	<.05	N/D	<.05	3.7
Chloroform	<.0001	<.002	<.0001	<.002	.0005	<.002	<.0001	<.002	.1
1,1-Dichloroethene	<.0002	<.002	<.0002	<.002	.0003	<.002	<.0002	<.002	.007
4-Isopropyltoluene	<.0001	<.002	<.0001	<.002	.0001	<.002	<.0001	<.002	*
Cis-1,2- Dichloroethene	<.0001	<.002	<.0001	<.002	.030	.0514J	<.0001	<.002	.07
Trans-1,2- Dichloroethene	<.0001	<.002	<.0001	<.002	.0028	.0026J	<.0001	<.002	.1
Trichloroethene	<.0001	<.002	<.0001	<.002	**.140**	**.139J**	<.0001	<.002	.005
Toluene	N/D	<.002	N/D	<.002	N/D	.0028J	N/D	.0028J	1
Vinyl Chloride	<.0002	<.002	<.0002	<.002	.0002	<.002	<.0002	<.002	.002
SVOCs									
Bis(2-ethylhexyl)phthalate	<.0006	<.01	<.0006J	<.01	1.0J	<.01	1.3J	<.01	*

MSCs action levels from Texas Risk Reduction, Standard No. 2, Appendix G
J - Estimated
ND – Non Detect N/A – Not Analyzed * - No action level provided
Bold/Shaded – Results above MSCs Groundwater Residential RR Standard No. 2

6.0 Executive Summary

This section summarizes the fieldwork, COPCs, and nature and extent of contamination defined by this ESI Phase II.

6.1 Field Sampling and COPCs

6.1.1 Soil

Previous site investigations indicated lead, zinc, and PCBs as the primary COPCs for surface soils. Potential areas for release were identified as the former sites for the cooling tower, incinerator, and UST. A total of sixty-one (61) surface soil samples were collected and analyzed for the eight (8) RCRA metals, zinc, and PCBs. Additionally, four (4) soil samples were collected and analyzed for the eight (8) RCRA metals, zinc, and PCBs to establish background concentrations. The average background results are presented in **Table 6.1.1** below.

Table 6.1.1
Average Background Concentrations

Analyte	Average	High	Low	Texas Specific Background Concentrations
Arsenic	.6 mg/kg	1.4 mg/kg	0 mg/kg	5.9 mg/kg
Barium	27.35 mg/kg	35.7 mg/kg	19.9 mg/kg	300 mg/kg
Chromium	4.3 mg/kg	6 mg/kg	3 mg/kg	30 mg/kg
Lead	2.7 mg/kg	3.3 mg/kg	1.7 mg/kg	15 mg/kg
Zinc	9.45 mg/kg	16.2 mg/kg	0 mg/kg	30 mg/kg
PCBs	<.0202	<.0202	<.0202	N/A

Texas Specific Background Concentrations – **Appendix H**
N/A – Not Available

Site specific background results are all lower then the Texas Specific Background Concentrations as indicated on **Table 6.1.1**. To achieve closure of this site under RRS-1, all detected soils metal concentrations would be required to be at or below the site specific background concentrations. This would require a significant amount of soil removal. It is recommended that site closure be preformed under RRS-II Res. concentrations as indicated in **Appendix G**.

On site surface soil sample results confirmed, the previous site investigations conclusion, that lead, zinc, and PCBs are above background levels and should be considered the primary COPCs for surface soils. Analytical results for all metals tested are below the soil RRS-II MSC levels for residential. However, all lead and several sample locations for PCBs detected concentrations exceeding the RRS-II MSC GWP values for soils residential.

6.1.2 Groundwater

Water samples were collected from the three shallow monitoring wells and one deep well and analyzed for the 8 RCRA metals, zinc, VOCs, SVOCs, Pesticides/PCBs, Herbicides, and TPH. The primary COPCs reported in the MK ESI 2001 final report were Acetone, Chloroform, 1,1-Dichloroethylene, 4- Isopropyltoluene, Cis-1,2-Dichloroethene, Trans-1,2-Dichloroethene, Trichloroethene, and Vinyl Chloride all confined to MW08, with the exception of Vinyl Chloride which was also found in MW09. Only, four (4) VOC compounds were detected during this ESI Phase II sampling event. The four (4) VOC compounds are; Cis-1,2-Dichloroethene, Trans-1,2-Dichloroethene, Trichloroethene, and Toluene. All four compounds are present in MW08. Toluene is also present in MW09. Only Trichloroethene is above the TNRCC RRS-II-Res MSC screening value of .005 mg/l for residential. Cis-1,2-Dichloroethene and Trans-1,2-Dichloroethene, detected in MW08, were below the TNRCC RRS-II-Res MSC screening values of .07 mg/l for Cis-1,2-Dichloroethene and .1 mg/l for Trans-1,2-Dichloroethene. Toluene concentrations in MW08 and MW09 were below the MSC screening value of 1 mg/l for TNRCC RRS-II-Res. No SVOCs, Pesticides/PCBs, Herbicides, or TPH were detected in any of the monitoring wells sampled during this ESI Phase II.

6.2 Nature and Extent of Contamination

Surface soil sampling around the incinerator, cooling tower, and former UST site detected lead, zinc, and PCBs in excess of the established background concentrations. It is clear from the samples collected during this ESI Phase II that the incinerator, cooling

tower, and former UST site are probable sources of contamination. Sampling results confirmed higher concentrations closer to the established source and decreasing concentrations as one moves away from the source. Background samples taken from around the site perimeter demonstrates no surface contamination is moving offsite. The surface soil analytical results presented in **Figures 3.1A, 3.2A, and 3.3A** show the extent of the surficial contamination is very limited in extent.

Groundwater analytical results detected trichloroethene in MW08 above the MSC screening values for residential use. One well is not sufficient to determine the extent or potential source of contamination for the trichloroethene detected in the shallow Seymour aquifer.

7.0 Recommendations

Based on the data gathered during this ESI Phase II and upon regulatory compliance review, the following recommendations for the former AMS No. 7 site are presented below. The recommendations for additional fieldwork and groundwater investigation listed below have also incorporated the comments and suggested/requested actions by the TNRCC in a letter dated September 24, 2001 to the USACE, Tulsa District. (**Attachment I**).

- Contamination has been identified and confirmed surrounding the incinerator, cooling tower, and former UST site. COPCs are lead, zinc, and PCBs, however none of the COPCs exceed the RR Standard 2 soil screening levels for residential use. Many of the soil sample results do exceed the values established for RR Standard 2 GWP. Therefore, further investigations need to be conducted to establish GWP. In the TNRCC letter dated September 24, 2001 they suggest leachate tests be conducted to determine site-specific soil to GWP values, in accordance with Texas Administrative Code Title 30 Part1 Chapter 335 Subchapter S Rule 335.559 subsection (g). Subsection (g) is based upon the original MK report that this site be closed as industrial. It has been recommended in this report that the site closure be based upon residential standards, so subsection (f) of the above referenced Texas Administrative Code should be applied. In particular subsection (f) (2) which defines the procedures required to meet GWP, "a concentration in soil that does not produce a leachate in excess of MCLs or MSCs for groundwater when subjected to the Synthetic Precipitation Leaching Procedure, Method 1312 of SW 846". Surface and shallow subsurface soil samples should be collected and analyzed for the total lead, zinc, and PCBs., along with leachate tests using the SPLP Method 1312. Samples should be collected from each boring at the surface, at two feet below surface and at three feet below surface. A total of four soil borings should be preformed at each identified source of contamination: incinerator, cooling tower, and former UST site. One soil boring should be located within the area of highest concentrations

for each identified area. Three additional borings should be located down surface gradient of the highest concentrations boring. Combining this new subsurface and leachate information with the current surface information, a detailed interpretation of both the horizontal and vertical extent of the metals contamination can be derived. Additionally, surface soil sampling should be preformed in areas where there is the potential for water run-off to determine if COPCs are being transported offsite. These surface samples should be tested for total lead, zinc, and PCBs.

- Additional ground water monitoring wells need to be installed up gradient and down gradient of MW08 to determine the down gradient extent and potential source of the TCE contamination in the Seymour aquifer and to comply with the recommendations of the TNRCC. These wells need to be drilled to a sufficient depth to adequately test the shallow aquifer estimated at 40 feet bgs. Subsurface soil samples should be collected from the boring of the monitoring wells. Samples should be collected at five (5) foot intervals or key stratum changes with a maximum of six (6) samples collected from each boring. Subsurface soil samples collected should be analyzed for the eight (8) RCRA metals, zinc, VOCs, SVOCs, pesticides/PCBs, herbicides, and TPH. Groundwater collected should be analyzed for the (8) RCRA metals, zinc, VOCs, SVOCs, pesticides/PCBs, herbicides, and TPH

- Perform a well survey of all wells located within one half mile of the site. The survey should included location, well owners, well construction details (if available), total depth of well and screened interval, producing aquifer, current status of the well, and usage or type of well. The well survey shall include a map showing the wells locations.

- Currently MW09 is the only groundwater monitoring well installed in the deep aquifer (San Angelos Formation). It was noted in the TNRCC September 24, 2001 letter to the USACE, Tulsa District, that to provide significant conclusions

regarding the potential for releases from the bottom of the silo, a deep well must be installed directly down gradient to the silo. MW09 is probably not currently located directly down gradient from the silo. Therefore, it is DEMS's and TNRCC's recommendation that a new well be drilled in the deep aquifer (San Angelos Formation), to an approximate depth of 200 feet, down gradient to the silo. Gradient direction can be approximated using existing geologic and hydrogeologic literature. Groundwater from this well should be tested for the eight (8) RCRA metals, zinc, VOCs, SVOCs, pesticides/PCBs, herbicides, and TPH. This will provide additional groundwater information from the deep aquifer in relationship to potential releases form the silo.

- The TNRCC, in there response letter dated September 24, 2001 to USACE, Tulsa District (**Attachment I**) regarding Comments and Notice of Deficiency for the MK ESI 2001 final report, requested immediate action on the following items:
    a) Immediately sample any water supply wells on the site or directly down gradient of the site.
    b) Report groundwater sampling results to the TNRCC within 7 days of receipt of the laboratory results. This reporting requirement will continue until further notice from the TNRCC.
    c) Immediately begin quarterly groundwater sampling of the existing wells.
    d) The TNRCC suggested that further analysis of groundwater should be limited to analytes previously detected in soils and groundwater and their degradation products.

Past investigative surveys have recommended that the AMS No. 7 be classified as an industrial site. Based upon the concentrations and types of COPCs identified in this ESI Phase II, there is no advantage to classifying this site as industrial. Closure can be meet using the residential RR standard II screening levels.

8.0 References

The following references were utilized in the preparation of this report.

American Society for Testing Materials (ASTM), 1990. Standards Practice for Description and Identification of Soils (Visual-Manual Procedure). ASTM D-2488-90.

Morrison Knudsen (MK), *Expanded Site Investigation Report, Former Atlas Missile Site No. 7, Vernon, Texas*, prepared for the U.S. Army Corps of Engineers (USACE), Tulsa District. (January 2001).

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